

# Next Generation Technology Swine Waste-to-Energy Project



**AgSTAR National Conference**

**June 11, 2013**

**By: William G. "Gus" Simmons, Jr., P.E.**

**Presented by: Marvin Cavanaugh,  
Cavanaugh & Associates, P.A.**

***Renewable Energy Generation  
and GHG Emission Reductions  
via Innovative Waste Management***

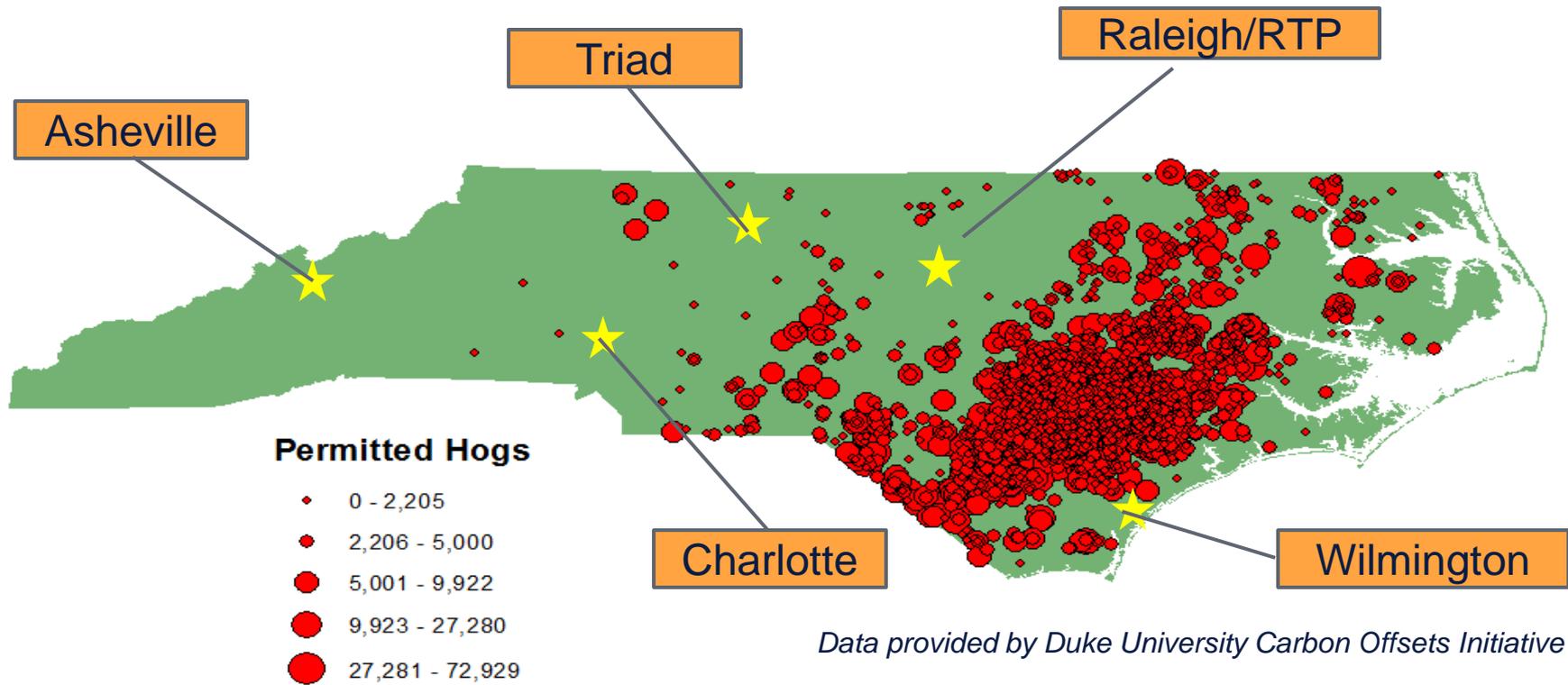


**CAVANAUGH**

*Stewardship Through Innovation*

# North Carolina Swine Energy Potential

2



## Why is NC Looking at Alternative Energy / Fuels from Ag Waste?

- NC Ranks 2<sup>nd</sup> in the US in pigs produced, with 15%; 2<sup>nd</sup> to Iowa
- NC Ranks 2<sup>nd</sup> in the US for turkeys produced with 13% after MN
- NC Ranks 10<sup>th</sup> in US for residential electricity consumption, per capita

# Commercial-Scale Demonstration Project: Loyd Ray Farms Swine Waste-to-Energy Project Converts waste from 9,000 pigs into electricity Improved Environmental Management



Map

Traffic

# How it Works

Raw Waste

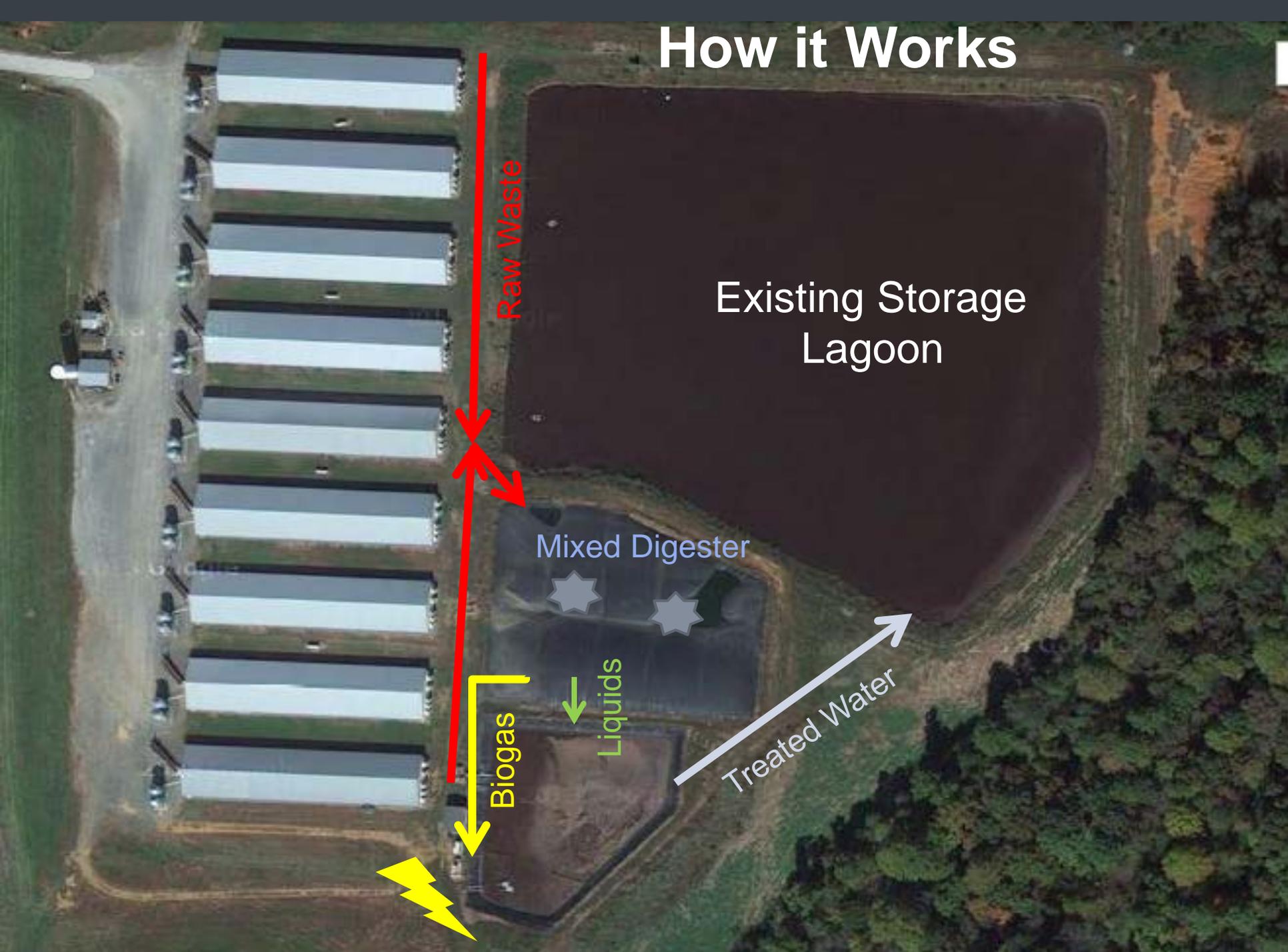
Existing Storage Lagoon

Mixed Digester

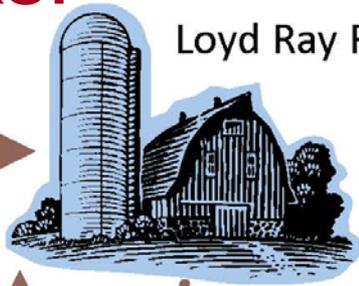
Biogas

Liquids

Treated Water

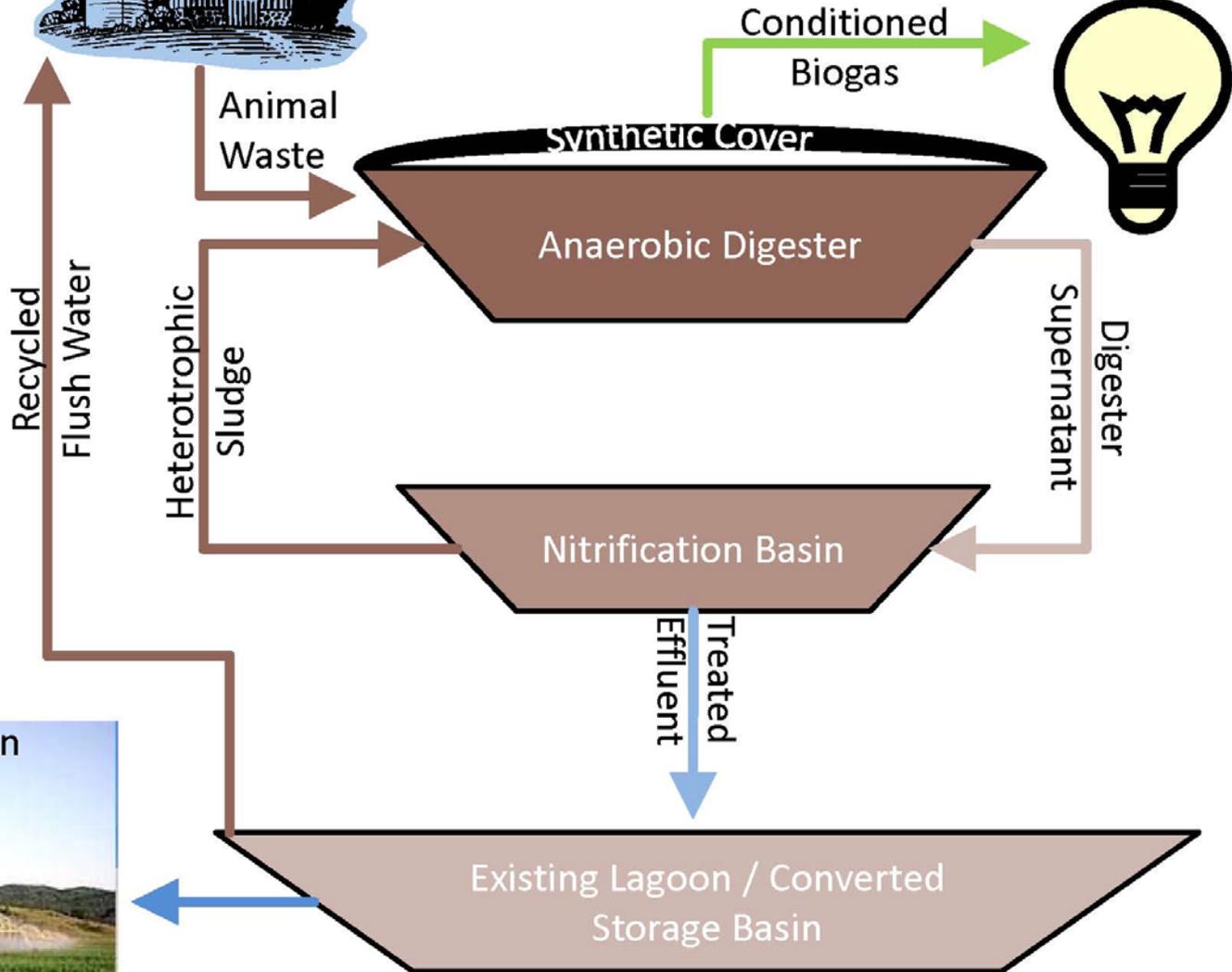


# How it Works:



Loyd Ray Farms Swine Waste-to-Energy Project

~65% CH<sub>4</sub>



Existing Farm Irrigation



*Photos by: Marc Deshusses, Duke University, 2011*



# Covered Anaerobic Digester

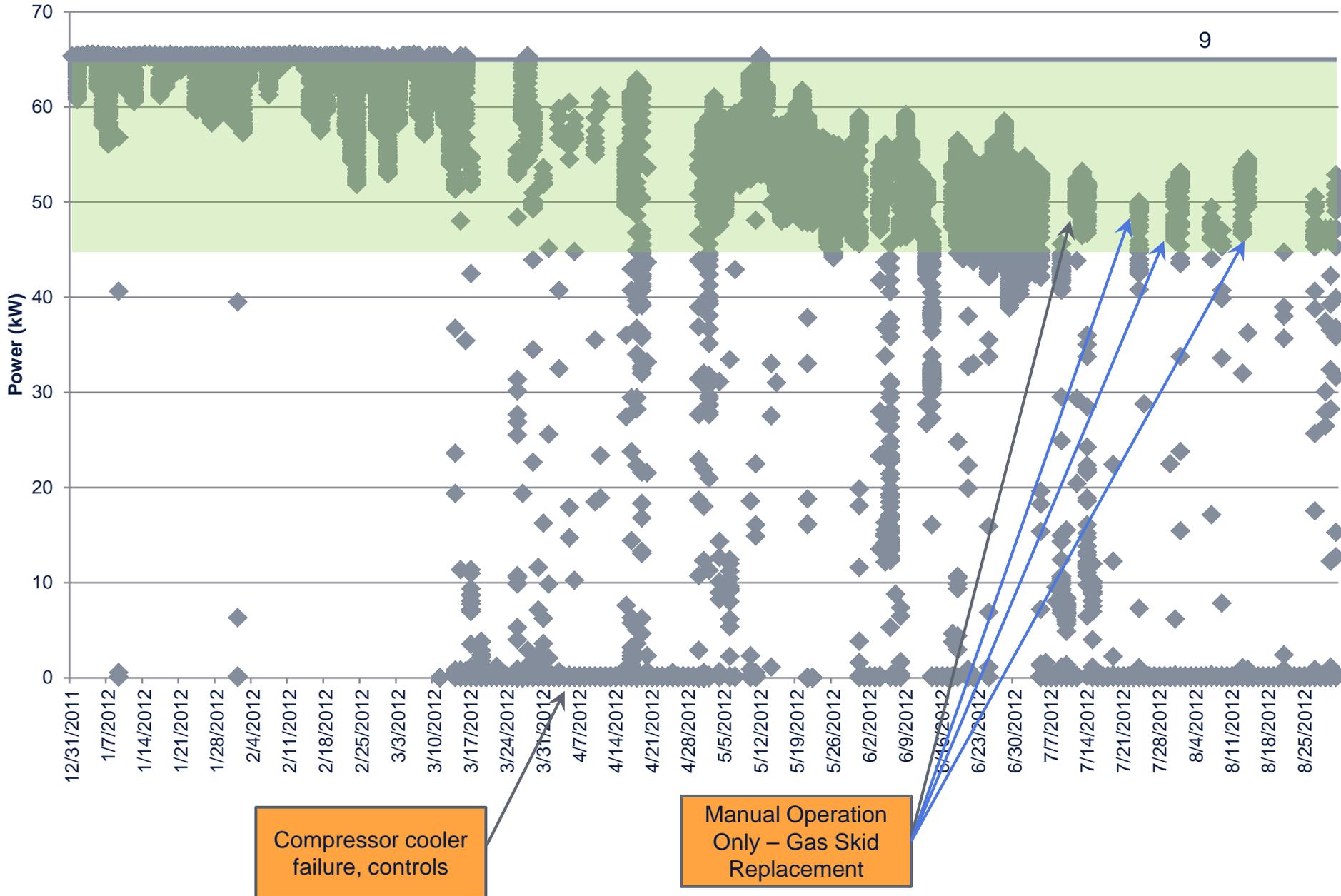


# Aeration System

8

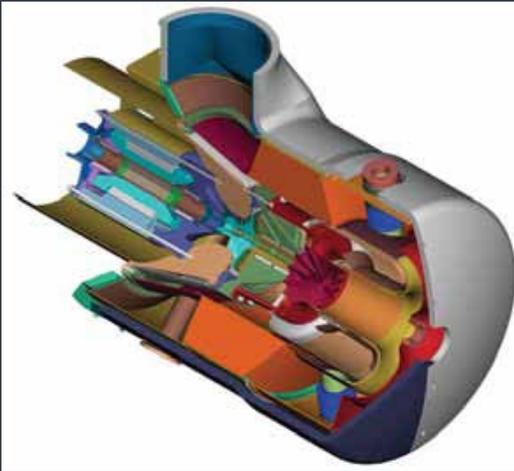


# Electricity Production Rate - 2012



# Gas Conditioning System & Microturbine

10



## Microturbine Specifications:

- 65 kilowatt Generative Capacity
- First Scheduled Service @ 8,000 Hrs
- Only one moving part → @ >90,000 RPM
- Air bearings – no lubricant or coolant required

# **A COUPLE OF FIRSTS:**

- **First Swine Waste-to-Energy project in the State of North Carolina to place RECs on the NC Utilities Commission REC Tracking System**
- **First Transfer of RECs from a NC Swine Farm to Duke Energy**
- **First ‘Innovative Swine Waste Treatment System’ permitted that utilizes digester**

# Costs and Benefits

12

## ■ Costs

- Capital: \$1.7M
- O&M: \$80,000/year

## ■ Funding sources

- NCACSP LCP
- CCPI/EQIP
- Sale of RECs to Utility
- Sale of Carbon Offsets (voluntary market)

*Note: No capital or operating costs passed on to farm owner! Farm owner receives excess electricity!!!*

## ■ Benefits

- Cash flow for farm owner
- Improved animal health
- Other ecosystem services (N, P control)
- Variability in nitrogen output for fertilizer
- Reduced sludge management cost
- Improved air quality on-site
- Reduction of odors off site
- More choice in cropping plan
- Sustaining NC Agriculture
- Reduced GHG Emissions

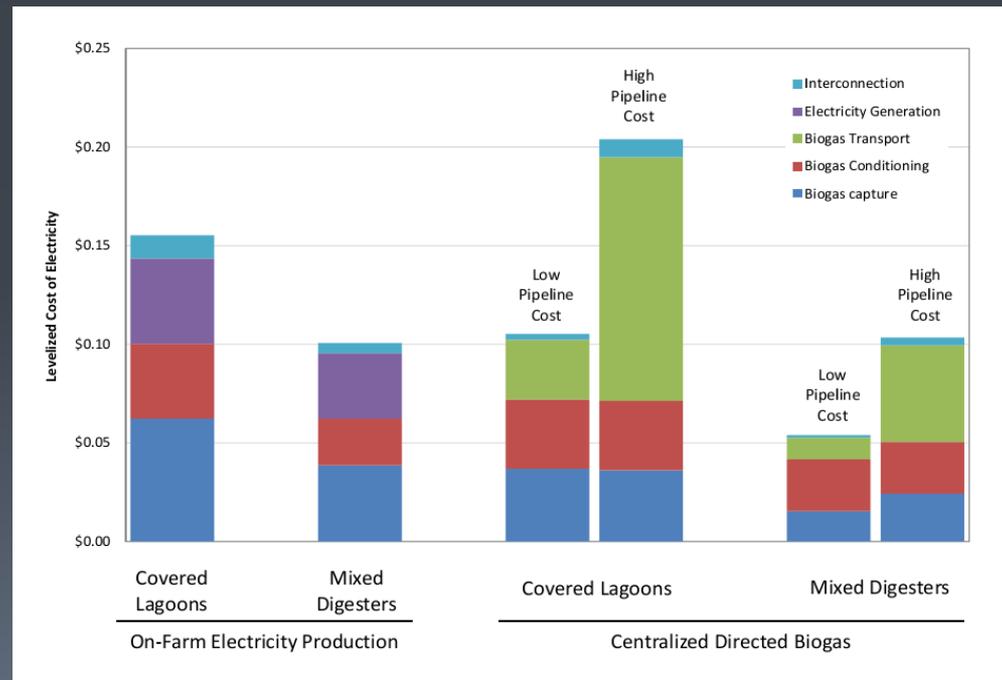
# Challenges & Lessons Learned: 13

- **Gas Skid Challenges** – Gas skid has suffered from multiple outages, which prevents REC generation, gas skid control issues
- **Abundance of Gas** – Very conservative on gas production expectations –
- **Electrical Load Balancing** – Environmental system operating at full capacity requires more electricity (demand) than the microturbine produces.
- **CAR Protocol Requirements** – Adding additional gas flow meters, thermocouples on flare, etc.

# Next Steps...

- In April 2013, Duke University released ENERGY GENERATION FROM SWINE WASTE: A SPATIAL-ECONOMIC OPTIMIZATION STUDY (OptimaBiogas Study)
- The analysis determined that the swine WTE portion of the REPS could be met with as few as 127 farms located in Sampson and Duplin Counties, assuming the use of highly efficient mixed anaerobic digesters to produce biogas (the fuel generated from swine waste) at each farm.
- Researchers evaluated four scenarios for producing electricity from swine waste-derived biogas, including:

1. On-farm electricity production, using on-farm digesters and on-farm generators;
2. On-farm digesters and biogas collection for direct injection into the existing natural gas pipeline;
3. Transport of biogas from individual farms to a centralized location for electricity production; and
4. Transport of biogas from individual farms to a centralized location for purification, pressurization and injection into the existing natural gas pipeline (and assumed combustion in a highly efficient combined cycle natural gas plant).



# Special Thanks

15



United States Department of Agriculture  
Natural Resources Conservation Service



**CAVANAUGH**

*Stewardship Through Innovation*



CONSTRUCTION

**GUEST**

**Mr. Loyd Bryant, Loyd Ray Farms  
LNH Farms**